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(54) Low profile, cord-less aerial

(57) A low-profile cord-less aerial comprises a conical monopole (4, 4') from conductive material immersed in a dielectric material (1) and a plate from conductive material (5, 5') located on said conical monopole.

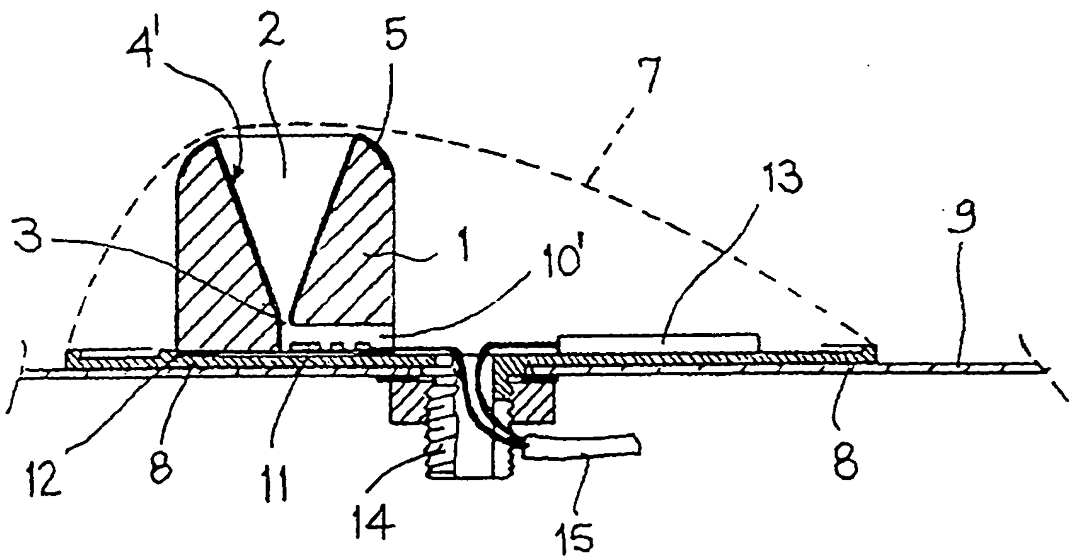

FIG. 4

Description

DESCRIPTION

[0001] The present invention relates to a low-profile cord-less aerial. More particularly, the present invention relates to a low-profile cord-less aerial especially suitable for applications on vehicles in general, such as motor-cars, trucks, buses, etc.

[0002] As is known, most aerials suitable for applications of the radiomobile type still are of the cord-type. Preferably, they are installed on the metal roofs of vehicles and are suitable to provide fairly good performances with vertical polarization, omnidirectional radiations.

[0003] More recently, more compact aerials having characteristics of lightness and reduced size have proved more successful. Such compact aerials are fitter for satisfying today's requirements, as regard both safety, through the elimination or the reduction as much as possible of the protrusions of vehicles, and the most advanced general style trends.

[0004] In the last years, with the rapid development of telecommunication systems, the aerials for motor-vehicles have been the object of further transformations in order to cause them to be adequate to the new requirements for the integration of telephony systems, with the ensuing necessity of having multifunction, wide band and increasingly high frequency characteristics.

[0005] The last generations of multifunction aerial commercially available are those with a low profile, realized with the technique of the so-called patch-aerials or microstrip-aerials. However, this type of aerials has the drawback or requiring very large and complex structures to perform satisfactorily.

[0006] Object of the present invention is to solve the aforementioned drawbacks.

[0007] More particularly, object of the present invention is to provide a low-profile multifunction aerial allowing to obtain satisfactory and wide band performance, employing a compact, limited size structure.

[0008] According to the present invention, these and still other objects that will be apparent from the following description, are obtained by means of a low-profile, cord-less aerial comprising a conical structure from conductive material, possibly immersed in a dielectric material, and a plate from conductive material located on said conical structure and that loads capacitively said conical monopole.

[0009] Preferably, the conical structure is a conical monopole from conductive material, that can be either solid or hollow.

[0010] Preferably, it is inserted in an upside-down conical cavity realized from a cylindrical block of dielectric material.

[0011] Therefore, according to a preferred embodiment, the low-profile cord-less aerial of the present invention comprises:

- a body of a cylindrical block of dielectric material provided with an upside-down conical cavity;
- a conical monopole from conductive metal material, that constitute the real radiant element of the aerial, inserted in said upside-down conical cavity; and
- a conductive metal plate, that loads capacitively said conical monopole, located on said conical monopole.

[0012] The low profile cord-less aerial of the present invention is characterized in that its loading may be carried out through a double system, namely the dielectric system and the capacitive system.

[0013] The low profile cord-less aerial of the present invention combines three basic concepts:

a) the concept of a conical monopole aerial on a mass plane, capable of generating a vertical polarization and operating on a wide band, with a sufficient gain;
b) the concept of a monopole loaded with dieletric material that allows to shorten the aerial, and
c) the concept of a monopole loaded with a metal plate connected to the end of said conical monopole, that allows to further reduce the size of the aerial, with respect to a fixed work band.

[0014] The advantages achieved by the low profile aerial of the present invention are numerous and evident. The aerial is compact, has a very reduced height and width, operates on a wide band and is effective for frequencies ranging from the present radiomobile applications to the future ones having higher frequencies up to 2,5 GHz.

[0015] The constructive and functional characteristics of the low profile aerials of the present invention will be better understood thanks to the following description wherein reference is made to the figures of the attached drawings that show some embodiments solely reported by way of non limiting example and illustration, and wherein:

Figures 1A and 1B show schemàtic front views of the cross sections of two different basic configurations of conical aerials of the present invention;
Figure 2 shows a schematic view of a cross-section of the loaded conical aerial of the present invention, associated to an impedance adjustment circuit;
Figure 3 shows a schematic view of a cross-section of a second embodiment of the loaded conical aerial of the present invention, associated to an impedance adjustment circuit, and
Figure 4 shows a schematic view of a cross-section of an application example of the conical aerial of the present invention, intended for the application on vehicle's roof.

[0016] With reference to the figures, the low profile

cord-less conical aerial of the present invention comprises a cylindrical body 1 from dielectric material, in whose middle an upside-down conical antenna 2 is obtained that has a through-hole 3 in correspondence of the down-turned top. The conical cavity 2 is either filled by a metal conductive body 4 or coated on the surface with a conductive metal layer 4'. Body 4 or the conductive metal layer 4' gets in touch with another plate-shaped conductive metal layer 5, 5', that covers the annular surface 6 of said dielectric cylinder 1. In the metal body 4 or the metal layer 4', inserted in the conical cavity 2, the structure is identified of a wide band conical aerial mounted on a mass plane and utilized for the generation of a vertical polarization.

[0017] In the cylindrical body 1, comprising the metal body 4 or the metal layer 4' inserted in the conical cavity 2, the structure is identified of a loaded monopole from dielectric material, that allows to shorten the aerial. In the metal plate 5, 5' that comprises either the metal body 4 or the metal layer 4', the structure is identified of a loaded monopole which, through the application of an equivalent capacity, allows to further reduce the size of the aerial.

[0018] In substance, the innovation of the present invention lies in that, in one only whole, the concept is utilized of the monopole loaded with dielectric material to reduce the resonance frequency and through which the whole of the antenna is caused to be more effective thanks to the utilization of the metal cone 4, 4', instead of the cylindrical monopole. In order to increase the effectiveness of the aerial and to obviate the problem of the currents that distribute in a non uniform manner along the radiant surface of the short aerials, the annular metal plate 5, 5' is introduced that has the effect of loading the metal cone 4 or 4' with a mass-directed capacity. Another innovating factor lies in the constructive configuration of the aerial, wherein the conductive metal cone 4 or 4' is located in the inside of the corresponding conical hole 2 obtained in the cylindrical structure from dielectric material 1, while the loading plate 5, 5' is located in the annular upper zone of said loaded monopole, in circumferential touch association with the metal edge of cone 4 or 4'. Both the conical aerial 4' and the loading plate 5 may be obtained by means of a spray or electrolytic bath metalization surface treatment, on the cylindrical element of dielectric material 1. However, such metalization system may also be obtained with other corresponding and suitable processes or by molding conductive laminations 4', 5' realized in a separate or united manner and applied subsequently in the corresponding surface zones, obtained in the cylindrical block of dieletric material 1. The upper annular surface 6 of said cylindrical block 1 and the above standing loading plate 5 or 5' may be realized according to a flat or spherical cap structure. In the latter instance the best compromise to obtain an efficient, shorter aerial, such as to be mounted under a covering and protection shaped cap for applications on vehicle's roofs 9, in compliance with the safety norms that suggest the utmost reduction in the protrusions and the absence of corners.

[0019] Alternatively, the conical aerial, described and illustrated until now according to hollow structures, may also be realized as a solid structure 4, maintaining its particular characteristics.

[0020] In order to obtain aerials with a still more reduced profile, the cylindrical body from dielectric material, instead of being realized with plastic materials such as nylon, may be realized with high dielectric constant synthesized ceramic materials. Besides, plastic and ceramic materials may be loaded with ferrites having a magnetic permeability greater than the unit.

[0021] For particular applications wherein the dielectric loading only may be sufficient, the aerial as a whole may be provided with the capacitive loading plate 5 or 5'. For particular applications wherein the capacitive loading only may be sufficient, the aerial as a whole may not be provided with the block of dieletric material 1.

[0022] The low profile cord-less aerial of the present invention is mounted on a base plate 8, to be applied with a gasket on roofs 9 of vehicles in general. Plate 8 may be provided with a room 10 for housing the impedance adjustment circuit 11. In an alternative, a corresponding groove 10' may be obtained on the base of said dielectric material; the latter solution is the one that allows to reduce to a level as low as possible the aerial as a whole, keeping its efficiency practically unchanged. In any case, the contact between the conductive metal cone 4 or 4' and circuit 11 is obtained by means of the through-hole 3 located in correspondence of the down-turned top. Mass 12 is located between the aerial and plate 8. On the base plate 8 a possible patch-aerial 13 may be located, either with or without a pre-amplifying circuit for the reception of the GPS system.

[0023] In the central part of plate 8 a hollow threaded connector 14 is present through which there is realized the fastening to roof 9 and the passage of cables 5 for the connection with the radio and/or telephone systems of vehicles.

[0024] The low profile cord-less aerial as described and characterized is advantageously utilized for frequencies ranging from the present radiomobile applications: 900 MHz - GSM - ETACS - AMPS- PDC, to the future higher frequencies up to 2.5 GHz, such as DCS - UMTS - PCN - PCD 1,5.

[0025] The aerial is particularly suitable for applications on remarkably high mobile means, such as trucks and buses or also motorcars having a roof higher than that of the normal sedans, for which reaching and unscrewing the cord before the automatic roller washing is difficult.

[0026] Although the invention has been described in conjunction with specific embodiments, offered for illustrative purpose only, it is evident that many alternatives and variations will apparent to those skilled in the art in the light of the foregoing description.

[0027] Accordingly, the invention is intended to em-

brace all of the alternatives and variations that fall within the spirit and scope of the appended claims.

Claims

1. A low profile cord-less aerial, **characterized in that** it comprises a conical monopole (4, 4') from conductive material possibly immersed in a dielectric material (1) and a plate from conductive material (5, 5'), located on said conical monopole (4, 4') for the capacitive loading.

2. The low profile cord-less aerial according to claim 1, **characterized in that** the conical monopole (4, 4') is inserted in an upside-down conical cavity, realized as a cylindrical block from dielectric material (1) for the dielectric loading.

3. The low profile cord-less aerial according to claims 1 and 2, **characterized in that it** comprises: a cylindrical body (1) from dielectric material having an upper annular surface (6) provided in the middle with an upside-down conical cavity (2) with a through-hole (3) in correspondence of the down-turned top, said conical cavity (2) being either filled by a solid body of metal conductor (4) or coated on the surface by a conductive metal layer (4'); and another plate-shaped conductive metal layer (5, 5') that covers the annular surface (6) of said dielectric cylinder (1).

4. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** it comprises a cylindrical body (1) from dielectric material, provided in the middle with an upside-down conical cavity (2) with a through-hole (3) in correspondence of the down-turned top, said conical cavity (2) being either filled by a solid body of metal conductor (4) or coated on the surface with a conductive metal layer (4').

5. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** the conductive metal cone (4, 4') is located in the middle of the cylindrical structure from dielectric material (1) and the loading conductive metal plate (5, 5') is located in the upper annular body (6) of the same loaded monopole, in circumferential touch association with the metal edge of the conductive cone (4, 4').

6. The low profile cord-less aerial according to any of claims 1-4, **characterized in that** the conductive metal cone (4, 4') is located in the inside of the corresponding conical cavity (2) obtained in the middle of the cylindrical structure from dielectric material (1).

7. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** the conical monopole aerial (4') is obtained by means of a spray or electrolytic bath metalization surface treatment, carried out on the conical cavity (2) of the loaded monopole (1) and that possibly extends beyond the edge of said cavity, in order to constitute the possible capacitive loading ring (5) of said conical monopole (4').

8. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** the conical monopole aerial and the possible loading plate are obtained by molding conductive laminates (4', 5'), and applied in the corresponding surface zones obtained on the loaded monopole element (1).

9. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** the cylindrical body (1) is realized with high dielectric constant synthesized ceramic materials, possibly loaded with ferrites having a magnetic permeability greater than the unit.

10. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** it is mounted on a base plate (8) with a room (10) for housing the impedance adjustment circuit (11) or a corresponding groove (10') obtained on the base of said dielectric material (1).

11. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** the upper annular surface (6) of the cylinder from dielectric material (1), and the underlying loading metal conductive plate (5, 5') may be realized according to a flat or spherical cap structure.

12. The low profile cord-less aerial according to any of the preceding claims, **characterized in that** a on the base plate 8 a possible patch-aerial (13) may be located, either with or without a pre-amplifying circuit for the reception of the GPS system.

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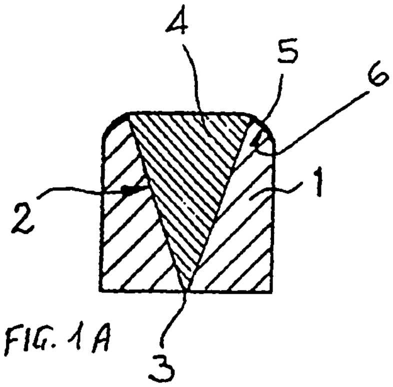

FIG. 1A

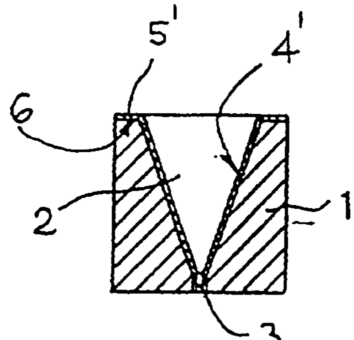

FIG. 1B

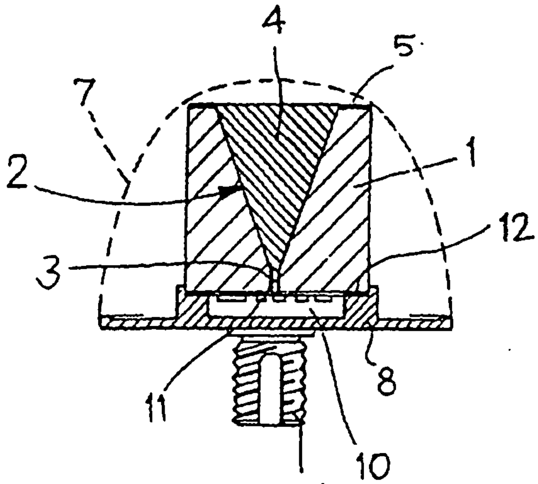

FIG. 2

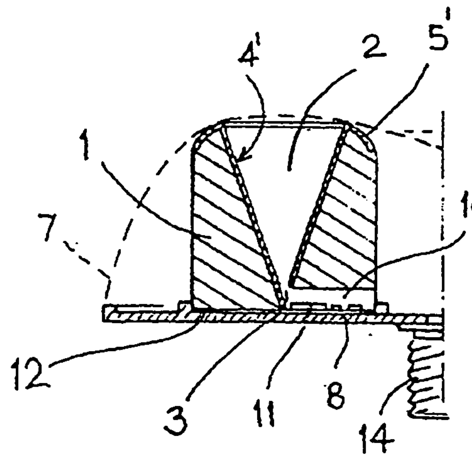

FIG. 3

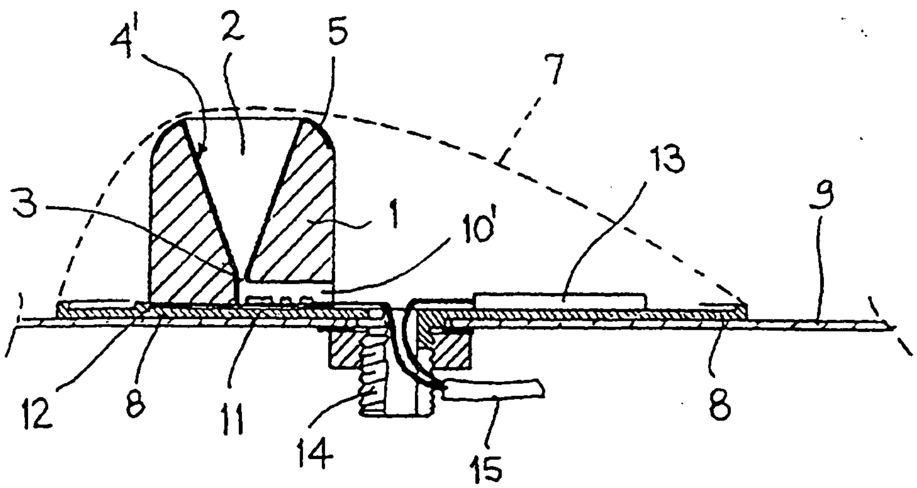

FIG. 4